ANNUAL MOVEMENTS OF A STEPPE EAGLE (*AQUILA NIPALENSIS*) SUMMERING IN MONGOLIA AND WINTERING IN TIBET[1]

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(*With one text-figure*)

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An adult female steppe eagle (*Aquila nipalensis* Hodgson) was captured and fitted with a satellite transmitter in June 1995 in southeastern Mongolia. In fall, it traveled southwest towards India as expected, but stopped in southeastern Tibet and wintered in a restricted zone within the breeding range of the steppe eagle. In spring, the bird returned to the same area of Mongolia where it was captured. These observations, though derived from the movements of a single bird, suggest three things that are contrary to what is generally believed about steppe eagle biology. First, not all steppe eagles move to warmer climes in winter. Second, not all steppe eagles are nomadic in winter. Finally, because our bird wintered at the periphery of the steppe eagle breeding range in Tibet, perhaps birds that breed in this same area also winter there. If so, not all steppe eagles are migratory.

The summer and winter ranges of the western race of the steppe eagle (*Aquila nipalensis orientalis*) have been mapped (Cramp and Simmons 1980). These birds breed from eastern Europe to eastern Kazakhstan and Kirgizia, and winter almost exclusively in Africa. Important migration concentration zones have been located (Welch and Welch 1991) and the migration of 10 birds has been followed by satellite (Meyburg and Meyburg 1995).

Less is known of the migration patterns and winter distribution of the eastern race (*A. n. nipalensis*) (Welch and Welch 1991, Watson 1997: 213). Thousands have been documented moving east-west at mid elevations paralleling the southern slopes of the Himalayas (Fleming 1983, Welch and Welch 1991). There is also some documentation of a trans-Himalayan migration. One was found dead on the south col of Mt. Everest at about 7,925 m (Singh 1961). Many birds have been seen traversing mountain passes in Nepal, with a maximum of about 100 birds per hr on 24 October (Inskipp and Inskipp 1985) and nearly 8,000 seen at one location in less than three weeks (de Roder 1989). Davis and Glass (1951) reported that steppe eagles were seen daily for a two-week period in October at Chihkiang (27.3° N, 110.1° E), Hunan, China.

The eastern race winters broadly across the Indian subcontinent, with a disjunct population in central and southern Myanmar (Smythies 1953, Cramp and Simmons 1980, Welch and Welch 1991). Some birds are mentioned wintering as far north as Nepal (Inskipp and Inskipp 1985). With recent deforestation, the species' wintering range may be expanding southward into and beyond peninsular Malaysia (Helbig and Wells 1990). These authors reported the first observation in Selangor (03.5° N, 101.2° E) in 1987. Further south, they reported single immatures in Singapore and Borneo. Stragglers have been previously reported from Hong Kong, Tenasserim (southern Myanmar: 12.1° N, 99.0° E) (Smythies 1953, King and Dickinson 1975), Viet Nam, and Thailand (Meyer de Schauensee 1984).

To improve our understanding of the migratory movements of eastern steppe eagles,

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we captured an adult female in 1995. This paper reports the movements of that bird over a 15-month period as revealed by satellite telemetry. Satellite monitoring of long-distance movements of flighted birds using the Argos Data Collection and Location System began in 1984 (Strickwerda *et al.* 1986) and is routine today, with transmitter packages (unfortunately dubbed Platform Transmitter Terminals, PTTs) as small as 30 g (and sometimes smaller). These PTTs, with careful programming, can provide data intermittently over the course of a year or more (see overview of system specifications in Meyburg *et al.* 1995).

Methods

As part of a larger study of raptors in Mongolia, in 1995 we focused on finding a steppe eagle eyrie with thermocompetent young, so we could capture and radio tag an adult without jeopardizing the young. We had originally planned to tag a fledgling. However, steppe eagles, which are migratory in Mongolia, nest much later than saker falcons (*Falco cherrug*) and golden eagles (*Aquila chrysaetos*), the primary objects of our study. The result was that during our May to mid-July surveys we were unable to find any nests with young large enough to safely outfit with a backpack harness (it is unsafe to place an adult-size harness on a downy chick).

After one month of searching, on June 26, we found a nest with chicks old enough to survive a mild night without being brooded. The three nestlings were about three weeks of age (based on photos of similarly developed golden eaglets). Although the chicks were much too young to harness, we returned at dusk that same night for an attempt to capture one of the adults. The adult male (dark morph) was roosting on a large boulder *c.* 100 m east of the eyrie: the adult female (pale morph) was on the nest with her chicks. Our plan was to wait until midnight and then try for the male first. Failing that, we would try and capture the female on the nest. From an earlier attempt to capture another roosting male, we knew that these birds would perch in one spot at dusk. Then, after it became too dark for us to see, they would fly to another location. This may be a predator avoidance adaptation of a species that very often roosts on or near the ground, and is thereby highly vulnerable to mammalian predation.

We began our capture attempt from camp, 1.5-2.0 km from the nest. All three persons in the team changed to dark clothing. It was a calm, starlit, moonless night. At 2330 hrs, we began our approach. Without headlights, we very slowly drove our motor vehicle, a Russian (UAZ) four-wheel drive, to within about 70 m of the nest. Then we propped open the hood, directing the engine noises toward the cliff. Next, we adjusted the throttle to about 1,500 rpm so the noise of our on-foot approach would be masked by the engine noises. We circled the hill so our approach would be from the darkest part of the sky. As we began the final approach to the male's roost, the capture person pulled wool leggings over his shoes and moved forward, holding a large (9V) battery-powered flashlight with strobe capability. When we were within 15 m, we began searching the boulder tops with the flashlight, but the male was gone.

Next, we began our approach on the female. At 60 m, we gave a slow series of eagle owl (*Bubo bubo*) hoots to encourage the female to stay on the nest and defend her young. At 10 m the lead person began to strobe the eagle at frequent intervals, to confuse the bird and to illuminate the cliff top. At 3 m, we could see two young in front of the adult, so we concluded that one must be beneath her. When 70 cm away, the flashlight was dropped and the lead person pounced on the eagle, pushing her, breast forward, into the nest but very quickly pulling her legs back beneath her tail so she could not damage the third chick with her talons. After

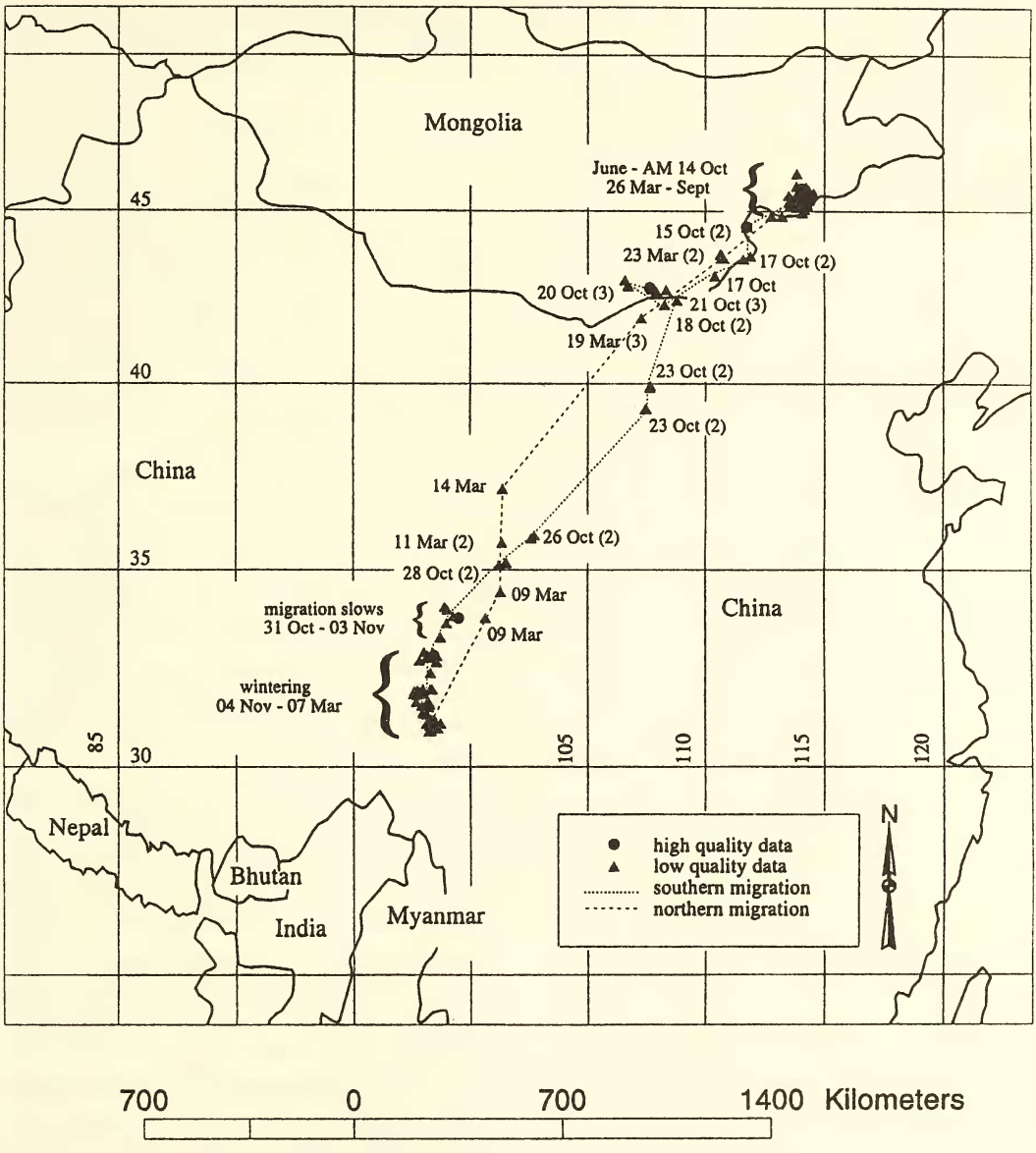

Fig. 1: Year-round (June 1995 to September 1996) movements of an adult steppe eagle. Numbers in parentheses following some dates indicate the number of satellite fixes for each location. Each fix is based on two (and usually more) location estimates. If the number of fixes is not provided for points along the migration route, assume one. Number of fixes is also not provided for termini and stopover locations where veracity of location is established by many points.

the female was lifted from the nest, we checked the chicks and saw that none were wounded during the struggle.

During the night, we attached the PTT, then socked the eagle to release her in the morning. By 0545 hrs on June 27, we were preparing the eagle for release. We cleaned her soiled ventral plumage with a water gun (Super Soaker), then decided to also wet her dorsal surface to discourage flight. In the 13th century C.E., Frederick II, Holy Roman Emperor, illustrated the ancient falconry technique of wetting a restive falcon's plumage to inhibit bating — a falconry term for a raptor's attempt to fly free (Wood and Fyfe 1969). At *c.* 0700 hrs, we placed her on the nest near the eaglets and sprayed her with more water. Then, with her legs still stretched out behind and a loose layer of paper over her head, we released her and crept silently to the car. We rolled the car, with engine off, down the hill away from the eyrie, then at 0741 hrs drove the car over the horizon: the female was still on the nest. At 1040 hrs, we returned to the area and using a telescope from a distant vantage point saw the female standing on the nest near her young.

Wishing to see if the eagle was encumbered by the harness, we returned at about 1400 hrs on June 28. The female was shading her chicks and allowed us to closely approach the eyrie before she flushed. When she flew, the radio was visible on her back, but she flew without any noticeable impediment.

The PTT used in the study was a 95 g unit manufactured by Microwave Telemetry, Inc. It measured 94 x 33 x 30 mm with a rearward projecting 216 mm antenna. The harness was a fall-free, crossed double loop of Teflon-coated nylon ribbon (13 mm wide) as described by Olsen *et al.* (1992 and unpubl. data). The PTT was programmed for four different transmission "seasons" as follows: Season 1, June 25 to September 1, 8 hrs on each 4.6 days; Season 2, September 1 to December 15, 8 hrs on each 1.6 days; Season 3, December 15 to February 1, 8 hrs on each 4.6 days; Season 4, February 1 to exhaustion, 8 hrs on each 2.6 days.

Results

For presentation here, we divided our location data points (fixes) into two quality classes. Higher quality fixes are believed to be within 1 km of the true location. Lower quality fixes (i.e. data derived from fewer or weaker signals), while of uncertain accuracy when treated individually, often provide very good approximations of the true location when two or more fixes are in one small area.

From our single PTT, we obtained 461 fixes of which 53 (12%) were high quality. The data track in Fig. 1 provides much useful information and some surprises. First, the wintering area used by our bird, extreme eastern Tibet, is north of the known wintering range for this subspecies in eastern Asia. Inskipp and Inskipp (1985) reported steppe eagles wintering in Nepal, but we know of no prior record of steppe eagles wintering in Tibet.

Our bird spent the period from November 4 to March 7 in the pre-cordilleran plateau between the Mekong and the Yangtze rivers. Although the summering area of this eagle in Mongolia was an area of high volcanic hills scattered across a level steppe at about 1,350 m elevation, her wintering area was a region of high ridges (up to about 4,000 m) and valleys (as low as 2,700 m) dominated by alpine meadow soils and covered with subalpine scrub and cold steppe with few forest patches. Nearby peaks rise to 4,300-4,600 m. Judging by elevation, the winter climate in Tibet would have been at least as harsh as if the bird had remained on the summering area in Mongolia.

Movements of the bird in her wintering area are also of interest. She arrived in the general area between October 28 and October 31, and settled into a rather restricted zone for

several days. Then she moved south approximately 100 km to spend the remainder of the winter in a narrow corridor about 300 km long. Although this area is large compared to the home range of a breeding eagle, it is small when compared to the movements of steppe eagles wintering in Africa (Watson 1997). There, they charac-teristically make repeated long distance movements as they search for termites which appear after rainstorms. Watson (1997: 99) placed the steppe eagle in the group of raptors characterized by nomadic, wide-ranging winter movements in search of abundant, but transient food. Our bird's movements were much more focused, suggesting that it was surviving on a food supply very different from that used by steppe eagles wintering in Africa.

Another temporal feature of interest is that the fall migration was more leisurely than the spring migration. The bird departed from the breeding area sometime after noon on October 14, and traveled rather leisurely for four days to an area about 600 km southwest. She remained there from October 18 to 21 or 22, then traveled rapidly for the last 10 days of October. Her general wintering area was about 1,350 km southwest of the fall "staging area" and about 2,000 km from the breeding area. Here again, the eagle paused for a few days (October 31 to November 4) and then moved south to the zone where she spent the winter (November 4 to March 7). Her northward journey began between March 7 and 9. By March 26, the bird arrived in the region where it had been captured the previous summer. No staging or stopover sites were observed on the northward trek. Gross rate of travel comparisons using median dates of arrival and departure are as follows:

Fall migration (total distance: 1,800 km), 20 days (October 14½ to November 3½): 90 km/day.

Spring migration (total distance: 2,200 km) 16½ days (March 8 to March 24½): 133 km/day.

Discussion

From this single bird, we learn: first, that although steppe eagles purportedly wander widely in winter, our eagle's winter range was restricted. Second, the winter range of the eastern race of the steppe eagle is purported to be India and Burma, with some birds in Nepal and stragglers south into peninsular Malaysia. Our bird wintered in extreme eastern Tibet at the periphery of the known breeding range of the steppe eagle. The steppe eagle is described as being entirely migratory (Cramp and Simmons 1980: 218, Welch and Welch 1991, Clark 1992), but because our bird wintered where or near where Tibetan birds breed, it is likely that some Tibetan birds winter in this same area and are, as a result, non-migratory. We urge that these novel ideas be explored by the deployment of more satellite transmitters on adult eagles in Mongolia and Tibet.

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